



## **LESSON #1 -- WHAT IS AN ESTUARY?**

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### **OBJECTIVES:**

- 1 -- Students will be able to define the terms estuary and watershed.
- 2 -- Students will learn the reasons for the salinity distribution differences within Peconic Bay estuary as the result of the input of fresh water.
- 3 -- Students will explore the many ways people use Peconic Bay's and the surrounding watershed for recreation. Also students will look at how heavy use in one area can impact the whole estuary.

### **ACTIVITIES:**

Students will conduct experiment to compare the density of fresh and saltwater.

If time permits in class or for a homework assignment, have students work on worksheet "Peconic Bay And You."

## BACKGROUND:

Water from all streams and rivers eventually drain into the oceans of the world. **The place where freshwater joins and mixes with saltwater is called an estuary.** This shallow mixing zone of fresh and saltwater creates a unique nutrient-rich environment for plankton, small fish, and shellfish.

In an estuary the least saline waters are near the point where freshwater enters the estuary as in a river and the most saline waters are at the mouth of the estuary near the open ocean. The salinity (concentration of dissolved salts in water) of an estuary is, therefore, found to be somewhere between that of freshwater (0-0.5 parts per thousand) and seawater (35 ppt).

The Peconic Bay Estuary consists of numerous bays, harbors, tidal wetlands, rivers, tidal creeks and 340 miles of coastline. Water enters the bay's waterways by the Peconic River, direct stormwater runoff, and groundwater flow from a drainage watershed area of approximately 110,000 acres. In the Peconic Bay Estuary freshwater from the Peconic River and several ponds and creeks flow into the salty tidal bays of the system. This mixing of fresh and saltwater produces a salinity distribution along the estuary ranging from less than 9 ppt at the mouth of the Peconic River, to approximately 30 ppt in Gardiners Bay (See map). Marine species in an estuary can be restricted due to salinity differences. For example in Peconic Bay, crabs such as blue, green, spider, lady and eelgrass prefer higher salinity and would be rare in Peconic River and Flanders Bay. Scallops prefer higher salinity but oysters can survive very well in lower salinity

In addition because of seasonal climate variations the salinity levels change in an estuary. Salinity levels are highest in the summer during time of high evaporation and low rainfall. In Spring or Winter salinity is lower because of less evaporation and high freshwater discharge into estuary from the surrounding watershed. Changes in salinity also effect marine life. Clams close up during periods of low salinity. After hurricanes or heavy rains a high mortality in oysters may occur because of sharply lower salinity.

The mixing of salt and freshwater is not always uniform in an estuary. If there is no wind or currents, a layer of freshwater may float on top of saltwater because of its lower density. In experiment #1 your students will discover and compare the densities of fresh and saltwater.

**A watershed is a region or area bounded peripherally by a water parting and draining ultimately to a particular body of water.** The Peconic Bay Estuary watershed drainage area includes the Peconic River with its headwaters in Ridge and Upton, to portions of Manorville and Calverton, and a large part of Riverhead at its mouth.

Land use along a watershed greatly impacts the health of an estuary. For instance, high density residential areas, industry and agriculture can add pollutants to ground and/or surface waters within the drainage area, either directly or by stormwater runoff. Thus, land use at the head waters of the Peconic River, approximately 15 miles inland can have far-reaching effects on the bay and should not be overlooked.

The Peconic River Watershed has a high percentage of open space that results in the high quality of water entering the bay. In 1989 26% of the 15,900 acres was open space and but of this acreage 39% is zoned for development. The future of the water quality of Peconic Bay depends on future land development and preservation of open spaces.

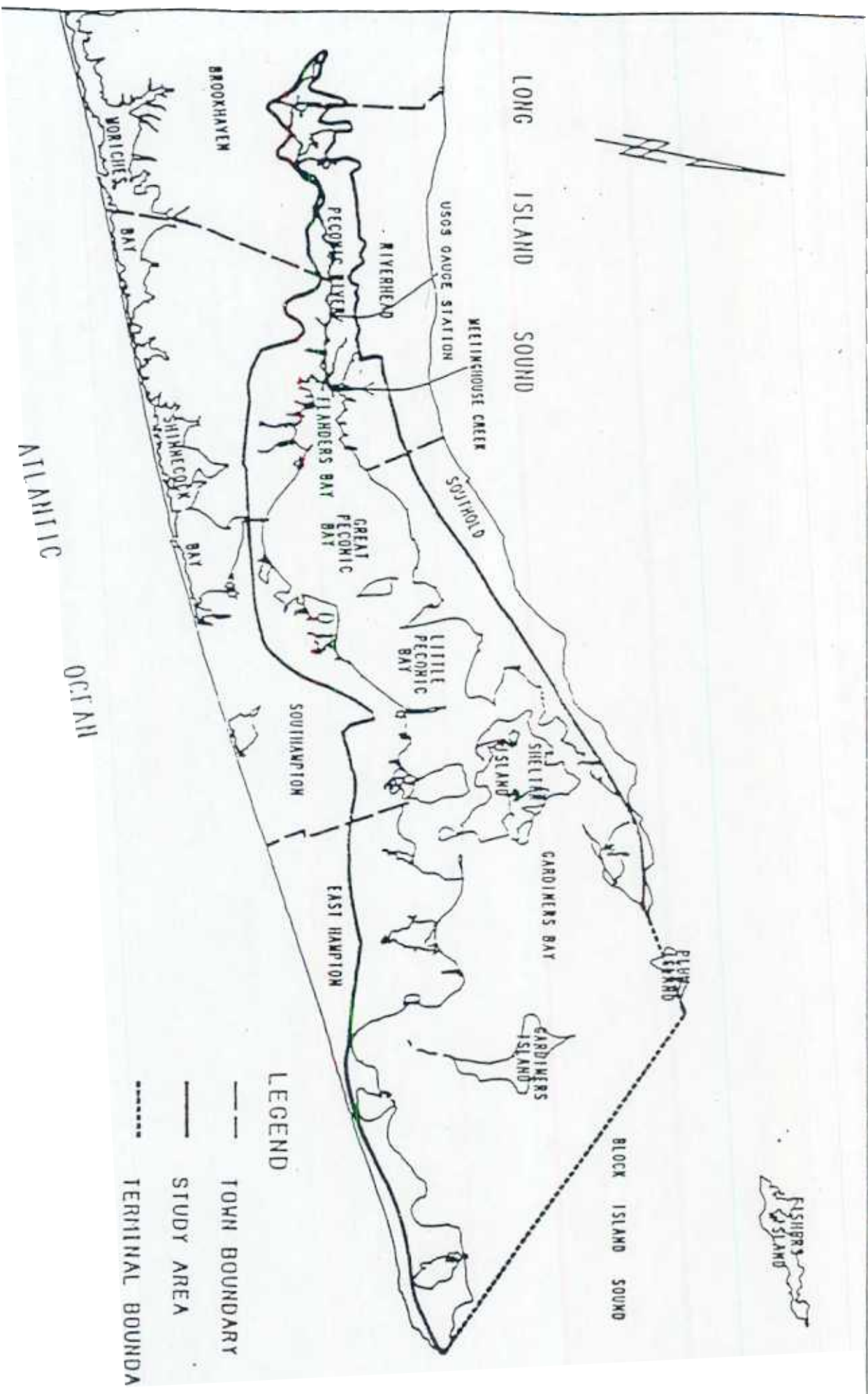
Peconic Bay and the surrounding watershed is a unique natural resource used by hundreds of thousands of Long Islanders and tourist annually. People from all walks of life use the Peconic Bay Estuary for swimming, hiking, boating, fishing, clamming and sightseeing. Students should begin to think about how they might be impacting the Peconic Bay Estuary and it's watershed, by addressing questions such as where they reside, and how they use the bay's resources for recreation. The future of the Bay's health will be determined by land use decisions, population growth, and our efforts to limit pollution entering the bay's waters.

## MATERIALS:

materials for Experiment #1 (see Experiment #1 sheet)  
map (transparency) of Peconic Bay  
transparency of salinity differences in Peconic Bay

## PROCEDURE:

- 1 – Discuss and define the terms estuary and watershed.
- 2 – Show students transparency map of Peconic Bay and identify various parts of the bay like: Flanders Bay, Great Peconic Bay, Robins Island, Shelter Island and Gardiners Bay .
- 3 – Ask students what factors may change the salinity levels in an estuary during a year. Give students clues to come up with differences in summer, winter and spring(Examples: evaporation, rainfall, and freshwater input).
- 4 – Show and discuss with students map transparency showing the average salinity distribution of Peconic Bay.
- 5 – Conduct Experiment #1 that compares densities of fresh and saltwater.
- 6 – Start worksheet in class if time permits or assign for homework.



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## EXPERIMENT #1 -- COMPARING THE DENSITIES OF FRESH AND SALTWATER

### MATERIALS:

4 one-gallon milk containers or equivalent (not provided)  
food coloring (blue and green)  
30 clear plastic cups  
15 dropping pipettes  
3.785 liters (1 gallon) tap water  
1 box of table salt

### PROCEDURE:

#### Part I

mix up salt water solution by adding 1/2 salt in box to 1 gallon of water.

Using food coloring, color 1/2 gallon of the fresh water dark blue, 1/2 gallon of the saltwater dark green. (You will need the extra gallon jugs to divide the water samples.) You will now have containers with clear fresh water, dark blue fresh water, clear fresh water, and dark green salt water.

- 3 -- Divide students into pairs and supply each group with two plastic cups and one dropping pipette.

Have students label one glass freshwater (F), one glass saltwater (S). (Use masking tape, or write directly on plastic cups with ink or markers.)

Fill glasses labeled F with clear freshwater, glasses labeled S with colored saltwater.



Have students pipette colored saltwater (green) into clear tap water. They should add approximately 20 to 30 drops until a layer of green seawater can be seen at the bottom of the glass. Be sure to instruct students not to stir the contents in the cups.

## Part II

- 1 -- Have students empty glasses and rinse glasses and pipette.
- 2 -- Fill glasses labeled S with clear saltwater, glasses labeled F with colored freshwater (blue).



- 3 -- Have students pipette colored freshwater into clear saltwater. They should add approximately 20 to 30 drops until a layer of blue freshwater can be seen on top of the saltwater. Be sure to instruct students not to stir the contents in the container.
- 4 -- Discuss with students their results and observations. (The salts in seawater make it denser and, thus, heavier than freshwater.)

### Notes:

A clear container needs to be used to see layering.  
Plastic is safer than glass.

Most towns recycle plastic, so help to reinforce recycling efforts by emphasizing to your students that the plastic cups will be recycled, if possible for other class projects. They can be used for planting seeds for plant projects.

## PECONIC BAY AND YOU

### Worksheet

NAME: \_\_\_\_\_

DATE: \_\_\_\_\_

- #1 Which is heavier, fresh or saltwater? \_\_\_\_\_ Explain your answer.
- #2 What is an estuary?
- #3 Can you name an estuary on Long Island?
- #4 You are in a boat near the mouth of a river that flows into an estuary. How would salinity change if you traveled to the open ocean end of the bay?
- #5 Describe in space below what happened in the experiment you did in class today.
- #6 In the experiment, why did we use food coloring in the salt and freshwater?

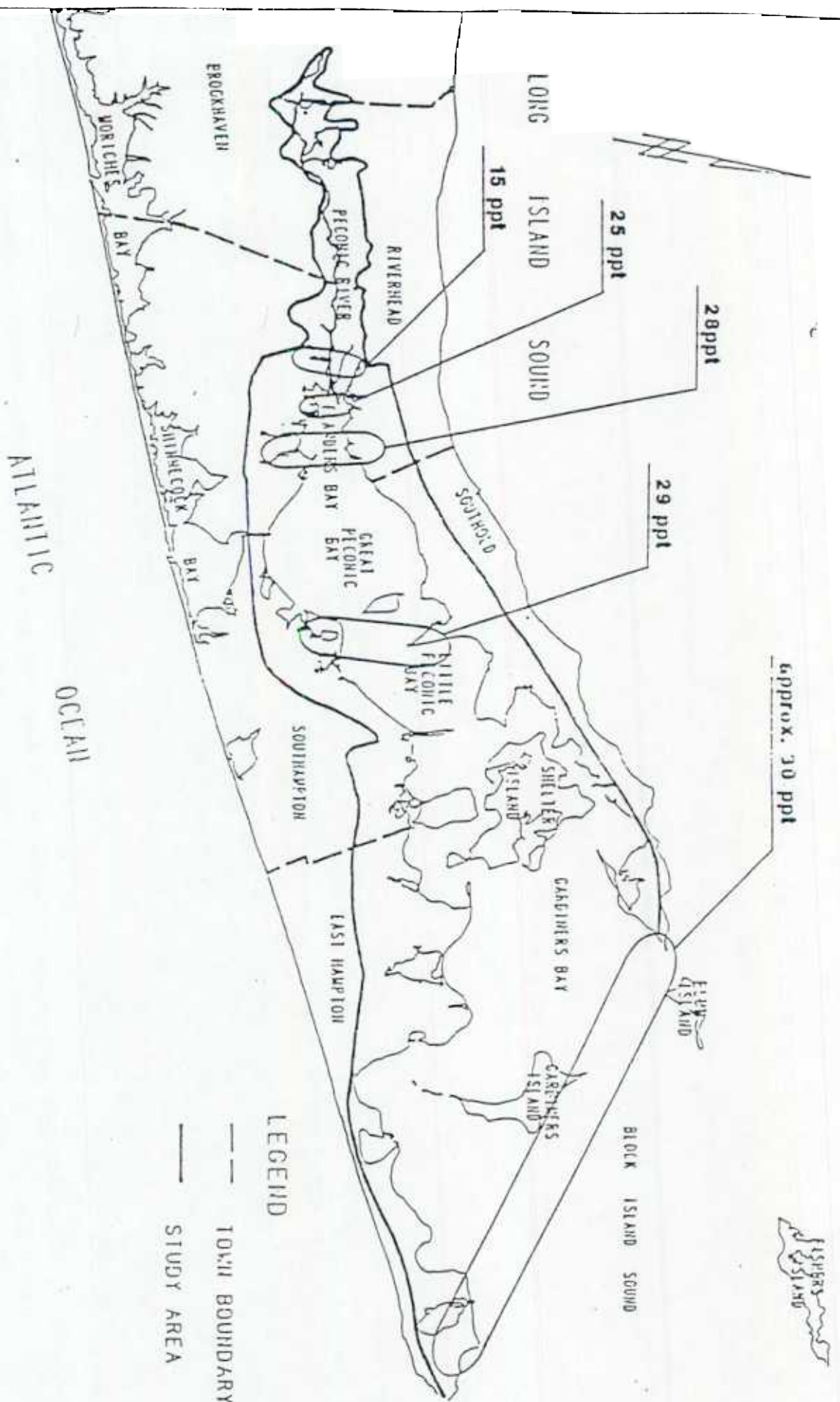


#7 List 5 different ways people use the Peconic Bay.

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#8 Describe any experiences or ways you use the Peconic Bay on a visit you had on the Bay.

#9 Describe three ways the bay's water quality is being damaged.



# APPENDIX A - 1 AVERAGE SALINITY DISTRIBUTION

SOURCE: SUFFOLK COUNTY

## LEGEND

- TOXIN BOUNDARY
- STUDY AREA

NO SCALE

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